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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/305,121	05/04/1999	SARATH D. GUNAPALA	06816/065002	1634

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EXAMINER	
BAUMEISTER, BRADLEY W	

ART UNIT	PAPER NUMBER
2815	

DATE MAILED: 02/09/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/305,121	GUNAPALA ET AL.	
	Examiner	Art Unit	
	B. William Baumeister	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on *17 November 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☐ Claim(s) *1,3,4,9,11-16 and 36-41* is/are pending in the application.

4a) Of the above claim(s) *9 and 37* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3,4,11-16,36 and 38-41* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *17 November 2003* is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Drawings

1. The corrected or substitute drawings were received on 11/17/2003. These drawings are **NOT** approved.

a. The reference numerals of various figures do not correspond to the reference numerals employed in the specification. For example, the specification sets forth numeral "220a" for the ground state (page 5, line 19), while Fig 2 sets forth ground state "220."

A proposed drawing correction or corrected drawings—including appropriate correction to each and every inconsistency, including those not specifically recited herein—are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

2. The disclosure is objected to because of the following informalities:

a. The specification sets forth, "the energy level separation and the depth of the quantum well are increased as the thickness of the GaAs layer is decreased." (Page 3, line 21-) It is true that the well thickness will affect the energy level separation, but the well depth is not affected by the well thickness. Rather, the well depth depends upon the height of the adjacent barrier layers.

b. Page 5, first full paragraph states that promotion is effective at holes 100 in the quantum well (no holes are depicted). Then, in the next paragraph numeral 100 is employed to describe the quantum well, itself--not the holes.

c. In regard to FIG 2, the specification sets forth numeral "220a" for the ground state (page 5, line 19), while Fig 2 sets forth ground state "220."

d. Page 7, lines 5-9 states: "...any barrier greater than 100 angstroms in thickness presents a formidable challenge for tunneling. The tunneling [sic: barrier?] for a bound-to-bound transition has typically more than 100 angstroms, and hence many of the electrons do not tunnel in this way." The latter sentence does not make sense.

e. The statement, "the photoelectrons are bound [sic: elevated?] into the continuum level..." (page 9, lines 3 -) is a non-sequitur.

f. Page, 10, lines 23- recites, "The quantum's depth and thickness of the quantum well are modified so that..." [sic: The depth and thickness...]

Appropriate correction to these and any other minor clerical errors not specifically recited is required in response to this Office action. Absent sufficient reason to the contrary, the objection to the specification will not be held in abeyance.

Claim Rejections - 35 USC § 103

3. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

4. Claims 1, 3, 4, 11-13, 15, 16, 36 and 38-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bois et al. '418 in view of Steele, "Importance of the upper state position in the performance of quantum well intersubband infrared detectors," Appl. Phys. Lett. 59 (27), 30 December 1991, pp. 3625-3627.

a. Bois teaches multi-color QWIP arrays composed of plural stacked individual QWIPs (PQ1, PQ2) responsive to different wavelengths, provided on a substrate, separated by a GaAs contact layer and having contacts C1, C2 and C3 attached to the QWIP stack (see e.g., FIG 9b). The wells of one QWIP are composed of GaAs and the wells of the other QWIP may be composed of GaAs/InGaAs/GaAs, while barriers of both QWIPs are composed of AlGaAs (e.g., col. 2, lines 53-; and FIGs 5b, 5c). Hence the conduction band has a smooth energy profile. The wells can also be composed of low-Al-content AlGaAs (col. 3, lines 60-67). Bois does not anticipate the claims because it teaches bound-to-bound transitions as opposed to Applicant's claimed bound-to-quasibound transitions.

b. Steele teaches the principles of bound-to-quasibound intersubband transitions. Specifically, it teaches that by properly selecting the well widths and the barrier heights, the upper bound state can be shifted to be resonant with the top of the barrier; and more specifically, that decreasing the well thickness increases energy difference between the subbands and raises the upper subband. Specific examples start with about a 35 meV (or about 12%) difference between the upper bound state and the barrier height energy, the subsequent examples show that the energy difference decreases and the upper energy level moves upwards as the wells are made thinner until the upper energy level is quasi-bound or resonant with the barrier. It further teaches that this resonance improves device responsivity, but that the responsivity drops off sharply once the upper state is pushed into the continuum. It would have been obvious to one of ordinary skill in the art at the time of the invention to have designed the barrier and well thicknesses and compositions of Bois so as to produce superlattices having quasi-bound transitions for the purpose of improving the QWIPs' responsivity as taught by Steele.

c. The independent claims have been presently amended to further require that the barrier have a thickness of at least 500 angstroms. Bois '418 further discloses that it was conventional for the QWIP's barriers to be 500 angstroms thick (e.g., FIG 4). Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to have specifically employed barriers that have a thickness on the order of 500 Angstroms as taught by Bois for the purpose of ensuring reduced dark current.

i. Applicant asserts in the REMARKS section that it was Applicant who discovered that the thick barriers on the order of 500 Angstroms can effectively reduce dark current. This argument is not persuasive because the prior-art Bois reference also teaches barriers having a 500-angstrom thickness. Moreover, Flore et al., "Strained InGaAs/AlGaAs quantum well infrared detectors at 4.5 um," Appl. Phys. Lett. 64 (4), 24 January 1994, pp. 478-480 evidences that it was previously known that dark current results at least in part from carriers tunneling through barriers (see page 479, col. 1, last paragraph).

5. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bois/Steele as applied to the claims above and further in view Bethea et al. 685 (previously made of record). Regardless of whether either of Bois or Steele further discloses the use of random reflectors, Bethea discloses that QWIP detector arrays may further comprise gratings or "diffusely scattering (roughened) surfaces" (or random reflectors) (col. 4, lines 15-21). It would have been obvious to one of ordinary skill in the art at the time of the invention to employ random reflectors in the Bois/Steele QWIP arrays for the purpose of increasing the coupling, as taught by Bethea.

Response to Arguments

6. Applicant's arguments with respect to the claims have been considered but are either not persuasive or are moot in view of the new ground(s) of rejection.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

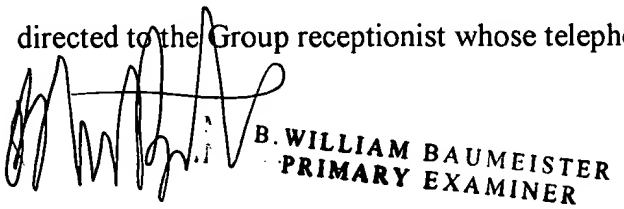
a. Liu '421 teaches that it was conventional to set QWIP barriers to a thickness of 500 angstroms (e.g., col. 3, lines 40-46).

b. Tidrow et al. "A high strain two-stack two-color quantum well infrared photodetector," Appl. Phys. Lett, 70 (7), 17 February 1997, pp. 859-861 teaches multicolor QWIP stacks with middle contacts (e.g., FIG 1) and discloses that the barriers may be 500 angstroms thick (e.g., page 859, col. 2, line 5).

c. Tidrow et al. "Grating coupled multicolor quantum well infrared phtodoetectors," Appl. Phys. Lett, 67 (13), 24 September 1995, pp. 1800-1802 teaches multicolor QWIPs with 500-angstrom-thick barriers (e.g., page 1800, col. 1, next to last paragraph).

Contact Information

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to the examiner, **B. William Baumeister,** at **(571) 272-1722.** The examiner can normally be reached Monday through Friday, 8:30 a.m. to 5:00 p.m. If the Examiner is not available, the Examiner's supervisor, Mr. Tom Thomas, can be reached at (571) 272-1664. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.



B. William Baumeister

Primary Examiner, Art Unit 2815

February 3, 2004